Hi, Here we have a student of Mark Merlin's Psychoactive Drug Plants Class at the University of Hawaii for Biology 401.

I would like to point out that there is disagreement between me and Mark Hofmann regarding the Andrija Puharich and His wife who claimed she saw magic mushrooms in the rainforest of Kauai similar to the Sacred Mexican Mushroom Species she observed on one occasion in Mexico with her husband..

However, She was not a mycologist, only saw the Mexican mushrooms on one occasion and her husband and her spent less than a week in Hawaii in the early 1960s.

I liken her identification to all of the people I show deadly Galerina Mushroom pictures to and have them tell me they ate them before and had rewarding experiences.

Anyway, I am sure she had no idea what she was talking about and Mr. Ross who wrote the paper also tends to partially agree.

The Mark Hofmann paper published in the Entheogenic Review talks about the mushroom like petroglyphs and mushroom like hats worn by ancient Hawaiian peoples. However since the cattle brought the Copelandia shrooms to Hawaii in the 1800s there were no magic shrooms in the islands prior to the coming of the white man.

Here is Mike Ross's paper.

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Mike Ross

Dr. Mark D. Merlin
Biology 440
4/20/04

Psychoactive Agaricales in Hawaii: A Contemporary Phenomenon?

Introduction

The organisms that will be discussed in this paper are all members of the Basidiomycota (gill fungi), a division of the Mycetae kingdom. Furthermore, they are in the order Agaricales, which contains a number of families possessing various species of psychoactive mushrooms (Singer 1975). Several of these psychoactive species can be found scattered across the Hawaiian Islands (Merlin and Allen 1993). For more than 30 years the recreational use of these psychoactive mushrooms has been well documented (Pollock 1974, 1976; Asuka 1985; Merlin and Allen 1989, 1993; Allen 1998). Although the utilization of psychoactive fungi in Hawaii by humans probably represents a contemporary phenomenon there is linguistic and iconographic evidence suggesting that an indigenous mushroom cult existed in pre-contact Hawaii (Hoffman 2002). The ensuing paper will explore this idea as well discuss the mycology, ecology, biogeography, biochemistry, neurophysiology, ethnomycology, and contemporary use of the psychoactive mushrooms found in the Hawaiian Islands

Methods

The methods utilized in researching psychoactive fungi in the Hawaiian Islands are almost exclusively restricted to the literature. These include library searches using “mushrooms in Hawaii”, “fungi in Hawaii”, “psychoactive fungi in Hawaii”, “hallucinogenic mushrooms in Hawaii”, and “entheogenic mushrooms in Hawaii” as generic keywords. Internet searches using the same keywords, in all cases, brought up John W. Allen’s website or websites with links to his. Library searches based on articles and books found in a bibliography prepared by John W. Allen and Jochen Gartz were conducted. The request of an interlibrary loan for a mycological taxonomy book by Rolf Singer was achieved. In addition, the Harvard Botanical Library was emailed to request an article written by R. Gordon Wasson. Also, the obtainment of several papers, surveys, and articles from Dr. Merlin was carried out. Personal communications were conducted as well. But by far, the most effective method was the searching out of articles referenced in papers concerning the use of psychoactive mushrooms in Hawaii.

Discussion

Mycology

In Hawaii there are approximately 255 species of Agaricales encompassing 13 families (Wong 2002). Presently 30 of these species, representing 6 families, are considered to be native with an 84% endemism rate. Of the 255 species of Agaricales found in the Hawaiian Islands 7 are known to be psychoactive. These include 6 coprophilous, or dung -loving, species in the family Coprinaceae and one non-coprophilous species belonging to the family Amanataceae (Merlin and Allen 1993; Wong 2002; Allen 1998).

The 6 coprophilous Agaricales in the Coprinaceae found in Hawaii are restricted to two genera, Copelandia Bresadola and Panaeolus (Fr.) Quel.. These species include Copelandia anomala Murrill, C. bispora (Malencon et Bertault) Singer, C. cambodginiensis (Ola'h et Heim) Singer, C. cyanescens (Berk. et Br.) Singer, C. tropicalis (Ola'h) Singer and Weeks, and Panaeolus subbalteatus (Berk. et Br.) Saccardo. The one non-coprophilous species in the Amanataceae is Amanita muscaria var. formosa Pers. (Merlin and Allen 1993; Allen 1998; Wong 2002).

According to Singer (1975) the family Coprinaceae consists of 7 genera and 3 subfamilies with Coprinus (Pers. ex) S. F. Gray being the type species. This melanosporous, or black-spored, family possesses a characteristic central stipe, is with or without a veil, typically exhibits non-deliquescing lamellae in species devoid of a volva, has a fleshy to membranous context, and shows signs of regular hymenophoral trauma, which becomes subregular with age. The habitat varies from occurring on different substrata, commonly on the earth, humus, dead wood, dung, fallen leaves, sand, in buildings, and in greenhouses to parasitic associations with other Agaricales. It appears that this melanosporous family is actually more closely related to the Bolbitaceae, a family that contains the psychoactive Conocybe spp., than to any of the other dark-spored families.

The genus Copelandia Bresadola, once thought to be a subgenus of Panaeolus, has given rise to considerable taxonomic dispute. The first taxonomic description of a Copelandia species was made in Sri Lanka in 1871 by Berkley and Broome. They described this species as Agaricus cyanescens, which was later revised and identified in the Philippines by Bresadola as Copelandia papilionacea (Pollock 1974, 1976; Merlin and Allen 1993; Allen 1998). In 1887 this species was again revised by Saccardo and described as Panaeolus cyanescens (Singer 1960). The taxonomic position of this species within the genus Panaeolus was maintained for the first half of the 1900?s. In 1942 it was described

from Floridia as Panaeolus westii by Murrill (Pollock 1974) and in 1949 was once again revised and described as Copelandia cyanescens by Singer (Schultes and Hofmann 1980). Although many authors disagreed with this classification, Singer (1975) argued that the genus Copelandia differs sharply from Panaeolus in the bluing context observed in bruised carpophores and the characteristic metuloids, which are otherwise absent in other members of the Panaeoloideae.

Ecology and Biogeography

Copelandia species are distributed throughout the tropics and subtropics of both hemispheres, although they do occur in temperate regions where they have been introduced, for example in France (Singer 1975). In the Hawaiian Islands these species occur on the islands of Oahu, Maui, Kauai, and Hawaii and are probably found on the islands of Molokai, Lanai, and Niihau (Merlin and Allen 1989, 1993; Allen 1998). Occurring most commonly in cow pastures these coprophilous species, except for C. anomala, inhabit the remnant dung deposited by cattle and have also been known to occur in grasslands where there had previously been manure deposited (Merlin and Allen 1989, 1993; Allen 1998; Hemmes and Desjardin 2002). In addition, Copelandia species have also been found growing on water buffalo dung, and in rice paddies (Allen 1998). All of the Copelandia species, as well as Panaeolus subbalteatus, found in the Hawaiian Islands were almost certainly introduced by cattle (Bos taurus), horses (Equus caballus), and/or other domesticated ungulates (Merlin and Allen 1989; 1993).

Copelandia species are characterized as having a fleshy, pigmented, campanulate pileus with cellular outer coverings and a slender, pigmented stipe, which turn blue when bruised or touched (Singer 1975; Schultes and Hofmann 1980). The lamellae tend to be variegated with numerous thick-walled metuloids on the sides. These metuloids have a subacute, narrowly mucronate subampullaceous apex, which is often solid and generally encrusted by crystals. Spores are black, ellipsoid to lemon-shaped, smooth, and have a broad, distinct germ pore, which is opaque and turns blackish (Singer 1975).

Copelandia cyanescens, often referred to as the “magic mushroom” of Hawaii, is the most commonly occurring psychoactive mushroom in Hawaii (Merlin and Allen 1989, 1993; Allen 1998; Hemmes and Desjardin 2002). It was first collected in Hawaii on the island of Oahu in 1974 by Pollock and identified by the French mycologist Roger Heim as C. cyanescens (Pollock 1974; Allen 1998). This species appears to originate from Asia and was probably introduced into Hawaii from the Philippines along with cattle in the early

1800?s (Merlin and Allen 1989). C. cyanescens is widely distributed throughout the tropics and neotropics of both hemispheres. It can be observed most abundantly in the Hawaiian Islands in the early part of spring and fall following heavy rains. Taxonomic characters include, a 15-40mm broad, hemispherical to campanulate to convex, dry to moist, brownish gray to off-white to pallid gray pileus, adnexed, close, mottled grayish black gills with thick-walled metuloids, a 80-100 X 2-3mm thick, cylindrical, fibrillose, pale yellowish to light brown stalk, and black lemon-shaped spores. Both the cap and stipe of this species bruise blue when handled or wounded (Merlin and Allen 1989, 1993; Allen 1998; Allen 2002; Hemmes and Desjardin 2002).

Copelandia anomala, which is a synonym for Copelandia cyanescens (Allen 2002), was first identified in Hawaii in 1975 by Rhoades (Merlin and Allen 1993). If in fact this species represents C. cyanescens the number of psychoactive species found in the Hawaiian Islands would be reduced from 7 to 6.

Copelandia cambodginiensis, originally described from Cambodia, has also been reported in France, Africa, Columbia, Mexico and Peru (Merlin and Allen 1993). Collections were first made in the Hawaiian Islands in 1990 near Kahaluu and Kuala, Oahu by Allen and identified in 1991 by Gerhardt as C. cambodginiensis. This species has a 12-25mm broad, conic to convex to hemispherical to plane, chocolate-brown to yellow cap, uncinate, ascending, pallid gills, black spores, an attached striate, whitish to cream color stem, and bruises blue more intensely than C. cyanescens or any other Copelandia species (Allen 1998). Merlin and Allen (1993) have noted that C. cambodginiensis differs from C. cyanescens in that it has smaller spores and thin-walled metuloids.

Copelandia bispora was originally recognized as only occurring in North Africa, however, was collected in 1987 from pastures on an experimental livestock farm in the North Shore of Oahu by Allen and then identified in 1989 by Guzman (Merlin and Allen 1993). Commonly occurring on Oahu and Hawaii this species can be found growing on the same dung heap as C. cyanescens (Allen 1998). C. bispora possesses a convex to hemispherical, smooth, non-viscid, yellow to pallid white pileus, adnate, crowded, black gills with white edges, a hollow stipe with white fibrils, and black spores (Allen 1998, 2002).

Copelandia tropicalis originates from Cambodia and has been observed growing on the dung of ungulate mammals in the Republic of Central Africa and Mexico (Merlin and Allen 1993; Allen 1998). This species was first reported in Hawaii in 1969 by Ola'h and then in 1975 and 1976 by Rhoades and Pollock, respectively (Allen 1998). As in the case of C.

cyanescens, C. tropicalis is thought to have arrived to the Hawaiian Islands via the import of cattle from the Philippines in the early 1800?s (Merlin and Allen 1989). C. tropicalis has a 15-25mm broad, hemispherical to convex to campanulate, pallid to gray to yellowish-brown pileus, adnexed, uncinate, mottled grayish-black lamellae, a 120mm X 2-3mm thick, hollow, yellow-brown stipe with white filaments at the base, and black spores (Allen 1998, 2002). Like the other Copelandia species C. tropicalis exhibits the characteristic blue coloring upon handling and damage.

Panaeolus subbalteatus, which was originally described from England in 1860 (Pollock 1976), is probably the least commonly collected coprophilous species in the Hawaiian Islands (Merlin and Allen 1989). This species has a cosmopolitan distribution reportedly occurring in Australia, Asia, India, North America, Central America, South America, Western Europe, Scandinavia, and Africa (Merlin and Allen 1993). On the slopes of Haleakala volcano in East Maui this Panaeolus species can be frequently found in pastures and wooded areas at about 3000 feet elevation.

It is also common in pastures and cattle grasslands of Hawaii Island. Despite the coprophilicity of this species it has been known to grow in paddocks, lawns, compost heaps, and decaying haystacks (Merlin and Allen 1993). P. subbalteatus has a 25-55mm broad, convex to campanulate to umbonate, hygrophanous cap with a cinnamon brown center surrounded by a grayish tan zone and a dark brown ring at the margin, adnate or adnexed, close, broad, mottled grayish black gills with white serrated edges, a 40-60 X 2-3mm thick dull fawn to reddish-brown, slender, cylindrical stalk with no veil remnants, and jet black spore deposits often with a purple hue (Ott 1976; Menser 1977; Allen 1998; Hemmes and Desjardin 2002). This species differs from the Copelandia species in that it does not show signs of the bluing reaction caused by handling or bruising and is devoid of the characteristic metuloids (Singer 1975). It should be noted however, that large specimens of P. subbalteatus have been observed on the volcanic slopes of Haleakala with significant bluing in the stems (Allen 1998).

Amanita muscaria var. formosa, which was most likely introduced into the Hawaiian Islands from the East Coast with Pinus taeda, is native to temperate forests of both hemispheres (Allen 1998; Wong 2002). This species has been reported from Pine tree plantations in Kauai, where it grows ectotrophically in association with Pine trees. Allen (1998) describes this species as having a 5-25cm yellow to bright red to red-orange, shiny cap with white flakes, white gills, a white, cylindrical stem with a bulbous base, and white spores. The usage of A. muscaria var. formosa in the Hawaiian Islands has never been reported in the literature and is doubtful (Allen 1998).

Biochemistry and Neurophysiology

Psilocybin (4-phosphoryloxy-N,N-dimethyltryptamine) and its dephosphorylated congener psilocin (4-hydroxy-N,N-dimethyltryptamine) were first isolated in 1958 by Albert Hofmann, the discoverer of LSD, and others (Schultes and Hofmann 1980). The structures of these two compounds were elucidated by means of degradation studies and then confirmed by synthesis (see fig.1 for structures). Psilocybin exists naturally as a white crystalline solid, dissolving readily in dilute acids, yet remaining nearly insoluble in most organic solvents, save for water and methanol in which it is sparingly soluble (Shulgin 1980). The psilocybin analog, psilocin, yields white crystals from methanol and is readily soluble in most organic solvents, however is insoluble in water and unstable in solution. Structurally psilocybin and psilocin represent novel compounds since they are the only known naturally occurring indole alkaloids with a phosphoric ester radical and the only 4-substituted indoles known to exist (Schultes and Hofmann 1980). Both psilocybin and psilocin are synthesized in vivo from the amino acid tryptophane. Experiments performed by Horita and Weber (1961), in which rat kidney homogenates were incubated with psilocybin, indicate that there was a rapid liberation of psilocin via the action of the enzyme alkaline phosphatase and that the psilocin generated underwent further degradation to form a blue-colored substance. Due to the fact that dephosphorylated psilocybin possesses a greater lipid solubility and therefore would, in theory, cross the blood-brain barrier more readily it seems reasonable to suggest ?that possibly in the intact animal psilocybin is rapidly dephosphorylated and is pharmacologically active as psilocin? (Horita and Weber 1961:47). Additional experiments conducted by Horita and Weber (1963), wherein pig heart homogenates were employed, determined that the mitochondrial enzyme cytochrome oxidase was responsible for the oxidation of psilocin into the characteristic blue-colored product.

Serotonin (5-hydroxytryptamine), a major mammalian neurotransmitter that bears remarkable structural affinities to both psilocybin and psilocin (see fig. 2), appears to be implicated in the biochemistry of the central nervous system (Schultes and Hofmann 1980). In fact, these chemicals are so closely related that they can easily be mistaken for one another when performing thin-layer chromatography (Gartz 1996). Bioassays of these compounds on isolated organs have been shown to exhibit pronounced inhibition of serotonin (Schultes and Hofmann 1980). These studies suggest that psilocybin and psilocin have ?characteristic autonomic effects: dilation of the pupils, contraction of the nictitating membrane, piloerection, temperature increase and so on? and that these substances have a low toxicity as indicated by the LD50 (Schultes and Hofmann 1980:76-77).

Figure 1.

The chemical structures of Psilocybin (4-phosphoryloxy-N,N-dimethyltryptamine) and Psilocin (4-hydroxy-N,N-dimethyltryptamine). From http://faculty.washington.edu/chudler/mush.html

Figure 2.

The chemical structure of Serotonin (5-hydroxytryptamine). Note the structural affinities between Psilocybin, Psilocin, and Serotonin. From http://faculty.washington.edu/chudler/mush.html

Psilocybin and psilocin ?are the only principles isolated from mushrooms which are capable of inducing psychomimetic effects in the human being following ingestion and are thus considered to be the main alkaloids attributable to their psychoactive effects (Benedict et. al.1962:156). That the psychoactive effects of mushrooms containing psilocybin and psilocin are caused by these two 4-substituted indole tryptamines has been established by reports of self-experimentations with psilocybin-containing mushrooms and pure psilocybin (Schultes and Hofmann 1980). According to Pollock (1976) when Hofmann ventured to Huautla Jimenez, the isolated Mazatec village where psilocybin-containing mushrooms have been employed traditionally for millennia, he offered the famous curandera Marina Sabina synthetic psilocybin who willingly accepted the tablets, however, did not prefer the artificial psilocybin to the actual mushrooms themselves. The psychoactive effects of psilocybin-containing mushrooms have often been compared to LSD and mescaline and found to be very similar in terms of the quality of the experience, yet differ in their relative durations (Schultes and Hofmann 1980). The use of these substances in psychiatry has been considered to be of great potential since they allow for a patient to enter a state in which they are completely divorced from the crippling anxieties of the present so that the patient can look dispassionately on his condition, perhaps come to understand it, and possibly learn to accept or correct it? (Lincoff and Mitchel 1977:131). Shulgin (1980) describes the human psychopharmacology of psilocybin.

A typical human dosage of psilocybin is 10mg of the alkaloid or from one to two g of dried Psilocybe sp. fruiting bodies. The central effects become apparent in about 20 minutes and develop with a startling rapidity over the following 20 minutes. There is frequently time distortion (subjective slowing) during this period. The activity plateau rarely

lasts more than an hour and is characterized by alterations in spatial and temporal perception, often with distortions in awareness of body image. Positive expectations usually lead to pleasant experiences and, conversely, anxiety or uncertainty can allow a difficult intoxication. In the absence of visual and auditory input (as with nighttime isolation) the experience can be largely fantasy and rich with hypnagogic imagery. Gradual recovery requires an additional two to three hours and there is a good recall of the phenomena experienced.

These psychoactive effects vary with the method of preparation and ingestion, with the most potent method being the consumption of dried mushrooms on an empty stomach (Lincoff and Mitchel 1977). Although anxiety may arise from these effects psilocybin is considered to be of no hazard to physical health (Hasler et al. 2004).

Other tryptamine-related compounds detected in psilocybin-containing mushrooms include, baeocystin, norbaeocystin, DMT, serotonin (5-HT), and 5-hydroxytryptophan (Schultes and Hofmann 1980; Merlin and Allen 1993).

The neurophysiological actions of these indoleamines seem to be derived from a direct interaction with the 5-HT2A receptor site for serotonin (Aghajanian and Marek 1999). Acting as 5-HT2A agonists, psilocybin and psilocin mimic the actions of serotonin by fitting into the same receptor sites and thereby assert their effects. Hasler et al. (2004:1) have shown that ?psilocybin affects core dimensions of altered states of consciousness and physiological parameters in a dose-dependent manner. These receptors are situated on the dendrites of neurons and play an imperative role in cognitive functions (Hasler et al. 2004). Aghajanian and Marek (1999: 16) have proposed that the effect of these indole chemicals on ?glutamatergic transmission in the cerebral cortex may be responsible for the higher-level cognitive, perceptual, and affective distortions produced by these drugs.

Psilocybin was first detected in the genus Copelandia in 1966 from samples of C. cyanescens collected in a garden in the southern region of France (Schultes and Hofmann 1980). It has since been confirmed that of the 5 other Coprinaceous species found in the Hawaiian Islands C. cambodginiensis, C. tropicalis, and P. subbalteatus all contain the 4-substituted indole tryptamine alkaloids, psilocybin and psilocin (Merlin and Allen 1993). Although there have never been any chemical analysis undertaken on C. anomala and C. bispora it is thought that these species do possess psilocybin and psilocin. The context for this assumption is based on the observed bluing reactions that occur when Copelandia spp. are bruised, which is now known to be attributed to the oxidation of psilocin (Horita

and Weber 1963; Merlin and Allen 1993). Chemical analysis of dried Copelandia specimens have revealed exceptionally high concentrations of psilocin. For example, when the basidiospores taken from a C. cyanescens specimen grown in Bali were cultivated at Sandoz Laboratories in Basel, Switzerland, the dried carpophores were found to contain 1.2% psilocin and 0.6% psilocybin, by far representing the highest concentration of these indole alkaloids ever reported (Schultes and Hofmann 1980). Specimens of C. cambodginiensis collected in Hawaii and analyzed for the presence of psilocybin and psilocin were shown to possess a higher concentration of these alkaloids than any other of the Copelandia spp. found in Hawaii (Merlin and Allen 1993). This seems to indicate that C. cambodginiensis is the most potent psychoactive species found in the Hawaiian Islands and may account for it bruising blue more intensely than other Copelandia species.

The non-coprophilous A. muscaria var. formosa, in contrast, does not possess these indole alkaloids, but rather contains ibotenic acid and muscimol, which not only differ from psilocybin and psilocin in terms of their chemical structures, but also differ in terms of the manifestation of psychoactive effects (Merlin and Allen 1993).

History of Human Usage

Modern or recreational use of psychoactive Agaricales in the Hawaiian Islands has been documented for more than 30 years (Pollock 1974, 1976; Asuka 1985; Merlin and Allen 1989, 1993; Allen 1998). The usage of these psychoactive mushrooms in Hawaii was first reported in 1972 in the Honolulu Advertiser and the Honolulu Star Bulletin (Allen 1998). Purportedly, an 18-year-old male from the mainland who was living in a tent on the North Shore of Oahu died shortly after admitting to have consumed 10 “magic mushrooms” (Allen 1988). Jonathan Ott later referred to this incident and suggested that the young man had in fact eaten a poisonous species inadvertently collected along with the psychoactive mushrooms (Allen 1998). John W. Allen, who also drew the same conclusion, in the summer of 1987 investigated this incident and discovered that the young man had actually died of a heroin overdose (Allen 1988).

The first published account of a psychoactive mushroom experience in Hawaii comes from Steven H. Pollock (1974). In his report Pollock tells of a vacation to Oahu in which he and a friend serendipitously happened upon the use of these mushrooms. During the winter of 1972 when he and a friend drove to Sunset beach to observe a surfing competition they encountered two hitchhikers, which were picked up along the way. In the course of conversation it was revealed that psychoactive mushrooms were used quite frequently by surfers residing in the North shore. Stimulated by this, he and his friend

decided to bioassay these mushrooms on themselves that very night. The experience which followed confirmed that these mushrooms were definitely psychoactive. A specimen collected that day was later mailed to Richard Evans Schultes who forwarded it to Roger Heim. He identified this specimen as Copelandia cyanescens based on microscopic examination of the spores and metuloids (Pollock 1974).

There are numerous articles found in different Hawaiian newspapers which report on the use of “magic mushrooms” in 1981. The first occurred on January 15 when a 14-year-old male was rushed to a hospital in Kailua for “gastric leverage” after an apparent overdose of psychoactive mushrooms (Allen 1998:7). Following this incident, on January 30 was the arrest of 8 individuals who were caught picking mushrooms at Kawainui swamp in Kailua. These individuals, 5 of which were UH students and 3 high school students, were charged for trespassing and promotion of illegal drugs and held for 48 hours before release. Several months afterward they were indicted by the Grand Jury for possession of controlled substances (Allen 1998). On February 8 in the same field in Kailua three marines, two soldiers, and a local man from Kahaluu were arrested for picking mushrooms (Allen 1998).

The next incident was reported on March 22 when a 17-year-old male from the Big Island self-inflicted multiple stab wounds upon himself after eating a small handful of psychoactive mushrooms (Stapleton 1981). Apparently this student of Kona High school had foraged for these mushrooms, which he called ?cone heads,? more than a dozen times and had never had a bad experience prior to this (Stapleton 1981:16).

A survey of the use of psychoactive mushrooms in Hawaii conducted between 1983 and 1984 showed that out of the total number of people surveyed 555 had actually consumed these mushrooms in Hawaii (Asuka 1985). Furthermore, this survey indicates that the majority of people first used these mushrooms for recreational purposes and that knowledge regarding them is primarily transmitted by friends. It also seems to suggest that the majority of people experienced pleasant effects while under the influence of these mushrooms.

The use of psychoactive mushrooms among students at a private school in Maui has been documented by Allen (1998). He has observed students of this school harvesting psychoactive mushrooms from the Makawao rodeo grounds located across the street from the school. These rodeo grounds house a number of paddocks where, during the rainy season, many species of psychoactive mushrooms can be found. Interviews with students observed picking these mushrooms reveal that most mushrooms picked are given away to

others or traded for pakalolo, but seldom reach the street level for illicit sale. The use among these students seems to be confined to parties; however the beach was also mentioned as commonplace to use these mushrooms, as well as while surfing.

Although psilocybin and psilocin are considered to be controlled substances there is no law prohibiting the possession of mushrooms containing these chemicals (Merlin and Allen 1989). In Hawaii there are rather strict penalties and fines for the possession of psilocybin (Allen 1998). However most individuals caught foraging mushrooms are arrested and/or fined for trespassing rather than for the actual possession of psilocybin (Merlin and Allen 1989).

Various common names are employed by contemporary users for the different psychoactive mushroom species throughout the Hawaiian Islands. These include: “shrooms”, “magic mushrooms”, “gold tops”, “gold caps”, “dimple tops”, and “cone heads” (Merlin and Allen 1989, 1993; Allen 1998). But by far the most frequently used term for psychoactive mushroom species by contemporary users in Hawaii is “shrooms” (Pers. Com. Anony. 2004).

Most mushroom foragers in Hawaii identify psychoactive species based on the bluing colorations that appear on the cap and stem upon handling (Pers. Com. Anony. 2004). As already mentioned, the bluing indicates the presence of the psychoactive tryptamine compounds, psilocybin and psilocin (Merlin and Allen 1993; Allen 1998).

Knowledge acquired in the Hawaiian Islands regarding the use of these psychoactive mushrooms seems to have come from Australian or New Zealand surfers (Allen 1998). This also probably includes the various methods of consumption, such as eaten fresh, eaten dried, infusions, and fruit-flavored mushroom smoothies (Allen 1998).

New methods, such as smoking the dried caps, have been employed more recently; however oral consumption of the fresh or dried mushrooms by ingestion or infusion seems to be the most popular method (Pers. Com. Anony. 2004). The utilization of mushrooms by inhalation may have been inspired by Carlos Castaneda’s “humito” (Pollock 1975). This mode of use is considered to require larger quantities of mushrooms and to be shorter in terms of the duration of effects. Pollock (1975) has put forth the idea that DMT, a known intermediary in the biosynthesis of psilocin and psilocybin, may mediate in the effects experienced from smoking the mushrooms.

Psilocybe cubensis (Earle) Sing., a widely known psychoactive mushroom, has been alleged to occur in grazing areas on the islands of Kauai and Hawaii, however there does not seem to be any evidence to support the claim that it is naturalized in the Hawaiian islands (Merlin and Allen 1993). Nevertheless, it may be grown in vitro and then sold illegally within the Hawaiian Islands. A spore entrepreneur from the mainland informed Allen that he sells ?5-10 complete P. cubensis growing kits each month to residents of Hawaii? (Merlin and Allen 1993:38). The exportation of psychoactive mushrooms out of Hawaii has been documented by Pollock. In the early 1970?s psychoactive mushrooms were exported on dry ice to California, but were spoiled and rendered inactive due to delays in the mode of dispersal (Pollock 1976). Advertisements for growing kits of "Hawaiian Cyan" strains, which probably have C. cyanescens spores, are also indicative of the export of psychoactive mushrooms from the Hawaiian Islands (Merlin and Allen 1993).

Elsewhere, these psychoactive mushrooms are also employed for recreational purposes. In Bali, the Philippines, Australia, New Zealand, Cambodia, Samoa, and Jamaica Copelandia species are frequently used in a non-traditional context (Pollock 1976; Cox 1981). Panaeolus subbalteatus is commonly used in the Pacific Northwest, in particular Oregon and Washington (Weil 1977), and throughout much of North America (Pollock 1976; Weil 1977) as well as in many parts of Europe (Pollock 1976; Gartz 1996), but does not seem to have any traditional utilization (Ott 1976).

Contemporary Phenomenon?

Evidence for the traditional use of psychoactive mushrooms in the Hawaiian Islands, although limited, nonetheless is extant. An account from the early 1940s of psychoactive mushroom use in Hawaii by a native from Maui to evict evil spirits when exorcising homes whose owners feared were possessed? (Allen 1998:5) suggests the possibility that entheogenic knowledge of their properties may have existed in the early 1900?s. It should be noted however that this person when questioned about the religious use of these mushrooms in Hawaii was unaware of anyone else who used them in such a manner (Allen 1998). Similarities between the Hawaiian root word ?akua,? which alludes to the supernatural, and the word "aku", found in five other parts of the world, brought Adreja Puharich, a psychic researcher, to Hawaii in 1961 to investigate the idea that psychoactive mushrooms were used in religious rites (Allen 1998). Along with David Bray, a well-known kahuna and professor of Hawaiian religion, Puharich researched records of Hawaiian culture, but found no evidence to substantiate this idea.

More recently, Mark Hoffman (2002:41) has argued that an “indigenous cult”, in which psychoactive mushrooms were utilized, existed in pre-contact Hawaii. Support for this claim is evidenced in iconographic renderings in the form of petroglyphs and helmets. The six mushroomic figures, thought to be objects of imitative magic, depicted on petroglyphs from Hawaii Island, Kahoolawe, and Lanai (see fig. 3 and 4) and a “mushroom helmet” worn by a native Hawaiian, as portrayed by Arago (see fig. 5), is suggestive of the possible use of these mushrooms in a traditional setting. This mushroom helmet, or “mahiole”, probably worn by alii is made of olona (Touchardia latifolia) cordage and the adventitious roots of ieie (Freycinetia arborea), both of which are endemic to the Hawaiian Islands (Abbott 1992:108). Whether or not Aragos depiction, which Hoffman has suggested as “obviously representing mushrooms”, does actually represent psychoactive mushrooms, it was still rendered in 1819, more than 40 years after contact. Hoffman maintains that the series of actions that would have had to occur in order for this to represent a post-contact phenomenon is unlikely and therefore concludes that this representing a pre-contact phenomenon “speaks for itself” (Hoffman 2002:45). Moreover he provides linguistic evidence that lends support to this notion. Enthralled by a traditional prayer, in which the sacred kava plant is referred to as ?excrement,? Hoffman explores the possibility that words endowing excrement with religious importance may yield significant insight into this matter. Thus, in hope of finding an association between the words ?dung? or ?excrement? and the supernatural, he checked Hawaiian dictionaries for terms related to “kukaelio”, or “horse dung.” In so doing, he came across the term “kukaeuau” listed as a medicinal plant, which he translates as “the excrement of rain” (Hoffman 2002:43). The root of this word “kukae”, which refers to excrement or fungi as in “kukaeloli” meaning mildew, combined with “ua”, meaning rain, and the last “u”, although not standard, is interpreted as designating a drug, as in “au.” He takes this to be a reference to psychoactive fungi. Other terms that may possibly allude to an indigenous mushroom cult include, “kukae-akua”, “god-dung” or “ghost-dung”, which is also called “huamai-lani”, meaning “fruit of the sky”, ascribes a supernatural origin to the excrement, and “ona”, meaning “mite” and “intoxication” (Hoffman 2002: 43-44). The latter term “ona” may be a reference to psychoactive mushrooms since it draws a connection between insects and intoxication “with dung/fungus being a breeding ground for those small insects associated with intoxication” (Hoffman 2002:43). In addition, the word “mite”, referring to something tiny, might insinuate that the mythological “menehunes” or “little people”, who resurrect decomposing tree trunks, are really mushrooms, seeing how this term also alludes to intoxication (Hoffman 2002:44).

Similar cases elsewhere in the Pacific may offer some objective perspective on this matter. Cox (1981) reports on the use of Copelandia cyanescens in a non-traditional context among younger Samoans living near the capital city Apia, in Western Samoa. Apparently they learned of its effects from a foreigner in 1975 who was visiting the island.

Among the older Samoans this mushroom goes by “faleaitu”, meaning “ghost house” or “comedy”, and “pulouaitu”, which means “ghost hat” (Cox 1981:115). The associations of these terms with ghosts ostensibly ascribes to them supernatural importance. Additionally, its relationship to the term ?comedy? is interesting since in both ancient Japan and China, a related mushroom, Panaeolus papilionaceus Fr. or the “laughing mushroom” was used very early on (Wasson 1959; Li 1977). Such terms appear to support the idea that the psychoactive properties of this mushroom were once known by older Samoans However the current unawareness of its properties by older Samoans strongly suggests that it was introduced (Cox 1981). Another case in Fiji, where there is a Stropharia species referred to as “viu-ni-tevoro” or the “devil’s parasol”, offers further insight (Wasson 1959: 26). Again this name seems to acknowledge its properties and imparts supernatural significance upon the mushroom, yet it is not utilized by native Fijians.

Results

Although the spiritual implications found in the Hawaiian terms referring to fungi are central to Hoffman’s argument, these cases may in fact show that the presence of a native term referring to a psychoactive mushroom might not necessarily indicate that it was used traditionally. The fact that two plants used in traditional Hawaiian culture also bear the root “kukae” and that no native fungi have been found to contain this root in their names inevitably leads one to conclude that this prefix is not always applied to fungi. Though intriguing, Hoffman’s hypothesis must also take into account that there are no known native psychoactive mushrooms species in Hawaii. As already mentioned, all of the 7 species of psychoactive mushrooms found in the Hawaiian Islands were introduced along with ungulates in the 1800s. The linguistic evidence presented by Hoffman also seems to imply that the fungal species in question is coprophilous, as it is associated with ?dung? and “excrement.” This, coupled with the fact that to date not one of the 30 native species of mushrooms found in the Hawaiian Islands is known to be psychoactive seems to preclude the idea that such mushrooms might be implicated in traditional Hawaiian culture—as it existed prior to the advent of Europeans.

Suffice it to say that these ideas warrant further investigation. For example, chemical analyses of the 30 native Agaricales, beginning with species belonging to families known to have psychoactive members, may establish a starting point for more involved research. If a species did test positive for the presence of psychoactive chemicals then a more thorough investigation into its possible use in traditional Hawaiian culture might be executed. Such studies might lend more credence to Hoffman’s hypothesis.

Considering that Copelandia species contain the highest percentages of psilocybin and psilocin, with psilocin being in a higher concentration, it seems that further chemical analyses on these species in Hawaii would be prudent. Also, the taxonomic ambiguity of Copelandia anomala merits further attention since it is not only used synonymously with C. cyanescens, but also with C. tropicalis.

Conclusion

That the use of psychoactive Agaricales in the Hawaiian Islands represents a contemporary phenomenon developing over the last 30 or more years seems to be evident. While the recreational use of these psychoactive mushrooms in Hawaii is well established today the possibility that they may have been used within the context of traditional Hawaiian culture looms large. However, the evidence to support the idea that psychoactive mushrooms were used in the Hawaiian Islands prior to contact is limited. Furthermore, the lack of a native psychoactive species undermines the stability of this contention. Thus, further investigation into the chemical nature of the native fungal species is warranted. Such work might serve as a compass heading for more involved and thorough ethnomycological research.

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